In re Patent Application of:
RIZZOTTO ET AL.
Serial No. **10/615,446**
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In the Claims:

Claims 1-10 (Cancelled).

11. (Currently Amended) A method of operating a quantum gate running ~~performing~~ a Grover's quantum algorithm ~~receiving a binary function having a basis of vectors of *n* qubits~~, the method comprising:

receiving at an input of the quantum gate a binary function having a basis of vectors of *n* qubits;

carrying out a superposition operation using a superposition subsystem coupled to the input, the superposition operation being carried out on input vectors for generating components of linear superposition vectors based upon a second basis of vectors of n+1 qubits;

carrying out an entanglement operation using an entanglement subsystem coupled to the superposition subsystem, the entanglement operation being carried out on components of the linear superposition vectors for generating components of numeric entanglement vectors, the entanglement operation generating, for components of each superposition vector, corresponding components of a numeric entanglement vector, each component based upon a respective vector of the second basis and being equal to one of the following

the corresponding component of the respective superposition vector if the binary function is null based upon the vector of the first basis formed by the first *n* qubits of the respective vector of the second basis, and

the opposite of the corresponding component of the respective superposition vector if the binary

function is not a null; and

carrying out an interference operation <u>using an interference subsystem coupled to the entanglement subsystem, the interface operation being carried out</u> on components of the numeric entanglement vectors for generating components of output vectors.

12. (Previously Presented) A method according to Claim 11, wherein the components of each output vector are even components, and odd components of each output vector are obtained by inverting the even components.

13. (Previously Presented) A method according to Claim 11, wherein the components of each output vector are odd components, and even components of each output vectors are obtained by inverting the odd components.

14. (Previously Presented) A method according to Claim 11, wherein even or odd components of a numeric entanglement vector are obtained by carrying out the following operations:

encoding components of each linear superposition vector with a low logic value if negative and with a high logic value if positive for generating components of encoded superposition vectors;

generating for components of each encoded superposition vector corresponding components of an encoded entanglement vector, each component based upon a respective vector of the second basis and being obtained by

copying the corresponding component of the

respective encoded superposition vector if the binary function is null in correspondence to the vector of the first basis formed by the first *n* qubits of the respective vector of the second basis, or

logically inverting the corresponding component of the respective encoded superposition vector if the binary function is not a null; and

decoding the components of encoded entanglement vectors for generating the components of numeric entanglement vectors.

15. (Previously Presented) A method according to Claim 14, wherein each of the components of an encoded entanglement vector is obtained by XORing the corresponding component of the encoded superposition vector with a value of the binary function corresponding to the vector of the first basis formed by the first *n* qubits.

16. (Previously Presented) A method according to Claim 11, wherein the interference operation comprises:

calculating a weighed sum with a scale factor of even or odd components of a numeric entanglement vector; and

generating each even or odd component of an output vector by respectively subtracting a corresponding even or odd component of a numeric entanglement vector from the weighed sum.

17. (Currently Amended) A method of operating a quantum gate running ~~performing~~ a Deutsch-Jozsa's quantum

algorithm ~~receiving a binary function having a basis of vectors of *n* qubits~~, the method comprising:

receiving at an input of the quantum gate a binary function having a basis of vectors of *n* qubits;

carrying out a superposition operation using a superposition subsystem coupled to the input, the superposition operation being carried out on input vectors for generating components of linear superposition vectors based upon a second basis of vectors of n+1 qubits;

carrying out an entanglement operation using an entanglement subsystem coupled to the superposition subsystem, the entanglement operation being carried out on components of the linear superposition vectors for generating components of numeric entanglement vectors, the entanglement operation generating, for components of each superposition vector, corresponding components of a numeric entanglement vector, each component based upon a respective vector of the second basis and being equal to one of the following

the corresponding component of the respective superposition vector if the binary function is null based upon the vector of the first basis formed by the first *n* qubits of the respective vector of the second basis, and

the opposite of the corresponding component of the respective superposition vector if the binary function is not a null; and

carrying out an interference operation using an interference subsystem coupled to the entanglement subsystem, the interface operation being carried out on components of the numeric entanglement vectors for generating components of

output vectors.

18. (Previously Presented) A method according to Claim 17, wherein the components of each output vector are even components, and odd components of each output vector are obtained by inverting the even components.

19. (Previously Presented) A method according to Claim 17, wherein the components of each output vector are odd components, and even components of each output vectors are obtained by inverting the odd components.

20. (Previously Presented) A method according to Claim 17, wherein even or odd components of a numeric entanglement vector are obtained by carrying out the following operations:

encoding components of each linear superposition vector with a low logic value if negative and with a high logic value if positive for generating components of encoded superposition vectors;

generating for components of each encoded superposition vector corresponding components of an encoded entanglement vector, each component based upon a respective vector of the second basis and being obtained by

copying the corresponding component of the respective encoded superposition vector if the binary function is null in correspondence to the vector of the first basis formed by the first *n* qubits of the respective vector of the second basis, or

logically inverting the corresponding component of the respective encoded superposition vector if the binary function is not a null; and

decoding the components of encoded entanglement vectors for generating the components of numeric entanglement vectors.

21. (Previously Presented) A method according to Claim 20, wherein each of the components of an encoded entanglement vector is obtained by XORing the corresponding component of the encoded superposition vector with a value of the binary function corresponding to the vector of the first basis formed by the first n qubits.

22. (Previously Presented) A quantum gate for running a Grover's quantum algorithm and comprising:

an input for receiving a binary function having a basis of vectors of n qubits;

a superposition subsystem connected to the input for carrying out a superposition operation on components of input vectors for generating components of linear superposition vectors based upon a second basis of vectors of n+1 qubits;

an entanglement subsystem connected to said superposition subsystem for carrying out an entanglement operation on components of the linear superposition vectors for generating components of numeric entanglement vectors, said entanglement subsystem comprising

a command circuit generating a plurality of logic command signals encoding values of the binary function corresponding to the vectors of the first

basis, and

circuit means being input with the logic command signals and generating for components of each superposition vector corresponding signals representing components of a numeric entanglement vector, each component referred to a respective vector of the second basis is equal to at least one of the following

the corresponding component of the respective superposition vector if the binary function is null in correspondence to the vector of the first basis formed by the first *n* qubits of the respective vector of the second basis, and

the opposite of the corresponding component of the respective superposition vector if the binary function is not a null; and

an interference subsystem connected to said entanglement subsystem for carrying out an interference operation on components of the numeric entanglement vectors for generating components of output vectors.

23. (Previously Presented) A quantum gate according to Claim 22, wherein said circuit means encodes components of each linear superposition vector with a low logic value if negative and with a high logic value if positive for generating signals representing components of an encoded superposition vector, said circuit means comprising:

an array of XOR logic gates each input with a signal

representing a component of an encoded superposition vector, and with a relative logic command signal for generating voltage signals representing components of encoded entanglement vectors; and

an array of digital/analog converters that decodes components of the encoded entanglement vectors for generating signals representing corresponding components of numeric entanglement vectors.

24. (Previously Presented) A quantum gate according to Claim 23, wherein each digital/analog converter outputs a signal representing the weighed difference with a second scale factor between the component of encoded entanglement vectors and a reference value.

25. (Previously Presented) A quantum gate according to Claim 22, wherein said interference subsystem comprises:

an adder being input with voltage signals representing even or odd components of a numeric entanglement vector, and generating a summed signal representing a weighed sum with a scale factor of the even or odd components; and

an array of adders each being input with a respective signal representing an even or odd component, respectively, of a numeric entanglement vector and with the summed signal for generating a signal representing an even or odd component, respectively, of the output vector as the difference between the summed signal and the signal representing an even or odd component of a numeric entanglement vector.

26. (Previously Presented) A quantum gate for running a Deutsch-Jozsa's quantum algorithm and comprising:

an input receiving a binary function having a basis of vectors of n qubits;

a superposition subsystem connected to the input for carrying out a superposition operation on components of input vectors for generating components of linear superposition vectors based upon a second basis of vectors of n+1 qubits;

an entanglement subsystem connected to said superposition subsystem for carrying out an entanglement operation on components of the linear superposition vectors for generating components of numeric entanglement vectors, said entanglement subsystem comprising

a command circuit generating a plurality of logic command signals encoding values of the binary function corresponding to the vectors of the first basis, and

a circuit being input with the logic command signals and generating for components of each superposition vector corresponding signals representing components of a numeric entanglement vector, each component referred to a respective vector of the second basis is equal to at least one of the following

the corresponding component of the respective superposition vector if the binary function is null in correspondence to the vector of the first basis formed by the first n qubits of the respective vector of the second basis, and

the opposite of the corresponding component of the respective superposition vector if the binary function is not a null; and

an interference subsystem connected to said entanglement subsystem for carrying out an interference operation on components of the numeric entanglement vectors for generating components of output vectors.

27. (Previously Presented) A quantum gate according to Claim 26, wherein said circuit encodes components of each linear superposition vector with a low logic value if negative and with a high logic value if positive for generating signals representing components of an encoded superposition vector, said circuit comprising:

an array of XOR logic gates each input with a signal representing a component of an encoded superposition vector, and with a relative logic command signal for generating voltage signals representing components of encoded entanglement vectors; and

an array of digital/analog converters that decodes components of the encoded entanglement vectors for generating signals representing corresponding components of numeric entanglement vectors.

28. (Previously Presented) A quantum gate according to Claim 27, wherein each digital/analog converter outputs a signal representing the weighed difference with a second scale factor between the component of encoded entanglement vectors and a reference value.